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SYNOPSIS OF RUDBECKIA SUBGENUS RUDBECKIA[1]

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Rudbeckia subgenus *Rudbeckia* includes those species in which the achenes are equably quadrangular with flat or convex walls that are completely filled and commonly expanded by the mature ovule. The achenes are typically truncate at the base and basally attached to the receptacle. The pales (chaff of the receptacle) are characteristically one and one-half to two times as long as the mature achenes. The group includes annual, biennial, and perennial plants.

This subgenus is essentially a group of eastern North American species. With the exception of the very weedy and widespread *R. hirta* var. *pulcherrima,* collections from beyond the eastern borders of the Great Plains are very rare. With the exception of *R. fulgida, R. hirta,* and *R. triloba,* the species occupy fairly limited geographic areas. *R. graminifolia* is apparently endemic to western Florida, records being available from but four counties.

The species of subgenus *Rudbeckia* are very distinct. No plants have been observed in the herbarium or during the course of extensive field study that offer even the most remote suggestion of interspecific hybridization. In nature the occurrence of colonies of two or more species within close proximity has been the rule rather than the exception.

The synonymy listed for the taxa is not necessarily complete; however, all important synonyms including names used in all of the floristic manuals have been included. Names of taxa below the rank of variety have been excluded. Most of these are included in the latest edition of Gray's Manual.

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[1] The research upon which this paper is based was initiated while the writer was a member of the staff of the Texas Research Foundation, Renner, Texas.

A detailed discussion of the morphological and cytological bases for the separation of *Rudbeckia* into two well defined subgenera will be presented in a forthcoming paper.

KEY TO THE SPECIES OF RUDBECKIA SUBGENUS RUDBECKIA

a. Leaves lanceolate (rarely broadly linear) or wider, never more than 6 times as long as broad, venation obviously pinnate; pales rounded to acute or cuspidate, never mucronate; rays usually yellow, occasionally brownish-red at the base.
  b. Style tips elongate, slenderly subulate ....1. *R. hirta.*
  b. Style tips short and blunt.
    c. Pales rounded, obtuse, or merely acute.
      d. Pales glabrous or rarely pilose with a few loose white hairs near the apex, apex entire, ciliate, or erose; leaves never glandular.
        e. Plants never stoloniferous, the leafy tufts arising only at the base of the stem; basal leaves broadly linear to lance-spatulate; stems and leaves densely villous-hirsute, branches sharply ascending ....2. *R. missouriensis.*
        e. Plants commonly stoloniferous, most of the leafy tufts arising at the ends of the stolons; basal leaves lanceolate or broader; stem and leaves nearly glabrous, hirsute, or strigose (villous-hirsute only in var. *deamii*); branches distinctly spreading ....3. *R. fulgida.*
      d. Pales canescent near the apex with short viscidulous hairs; leaves commonly glandular as evidenced by the presence of minute globules of clear brownish exudate (leaves non-glandular in *R. mollis* in which species stem is densely pilose near the base).
        f. Leaves entire or coarsely toothed, never deeply lobed.
          g. Stem densely pilose below; basal leaves spathulate and sessile or with broadly winged petioles; plant annual ....4. *R. mollis.*
          g. Stem glabrous below or with a few coarse hairs; basal leaves broadly elliptical or ovate, borne on long slender petioles; plant perennial.
            h. Achene crownless or crown, when present, very obscure; heads 4-8; rays spreading. 5. *R. heliopsidis.*
            h. Crown of the achene conspicuous; head usually solitary; rays reflexed ....6. *R. grandiflora.*
        f. At least some of the leaves deeply 3(–5)-lobed 7. *R. subtomentosa.*
    c. Pales acuminate-cuspidate ....8. *R. triloba.*
a. Leaves narrowly linear, grass-like, at least 10 times as long as broad, veins apparently parallel; pales mucronate; rays deep reddish-brown to orange red ....9. *R. graminifolia.*

1. **Rudbeckia hirta** L. This is a complex species but hardly so confusing as would be suggested by the abundance of names that have been assigned to its variants. There are numerous local variants and minor forms that are unworthy of recognition. Within the species, however, five fairly well defined geographic variants can be recognized as outlined below, although where ranges overlap there is often great morphological intergradation between varieties.

KEY TO THE VARIETIES OF R. HIRTA

a. Stem branching above the middle (if simple, the peduncle not more than 1/3 as long as the height of the plant), the branches ascending; plant of wide distribution.
  b. Leaves coarsely toothed, basal leaves broadly elliptical to oval, 2.5-7.0 cm. wide, blades mostly twice as long as wide, cauline leaves ovate-lanceolate or ovate, the sessile ones commonly pandurate, plant mostly of Appalachian Highlands (Pennsylvania to Georgia and Alabama; sparingly north to Maine, west to Illinois) ....1a. var. *hirta*.
  b. Leaves entire or finely serrate, basal leaves narrowly to broadly oblanceolate or lanceolate, 1–2.5(–5) cm. wide, blade (3–)4–5 times as long as wide, cauline leaves spatulate, oblanceolate or broadly linear.
    c. Stem simple or branching near the middle, peduncles at least 7 cm. long, 1/5–1/3 as long as the total height of the plant (Newfoundland to British Columbia, south to Florida and northern Mexico; apparently rare west of the Rocky Mts.) ....1b. var. *pulcherrima*.
    c. Stem branching near the apex, peduncles 1–6 cm. long, never more than 1/7 as long as the total height of the plant (Virginia coastal plain) ....1c. var. *corymbifera*.
a. Stem branching at and below the middle (if simple, the peduncle at least ½ as long as the height of the plant), the branches divergent; plant of the lower Gulf Coastal Plain from Florida to southern Texas.
    d. Stem branching at or near the middle, rarely at the base, never scapose; leaves mostly pale green (to brownish when dry), hispid to somewhat sericeous, rough but never extremely harsh to the touch, basal leaves narrowly to broadly oblanceolate (coastal plain, southern Georgia to Florida, west to southern Texas) ....1d. var. *angustifolia*.
    d. Stem branching at or near the base, often scapose; leaves mostly dark green, scabrous or hirsute, very harsh to the touch, basal leaves broadly obovate or nearly orbicular to broadly oblanceolate (central and southern Florida) ....1e. var. *floridana*.

1a. **R. hirta** L. var. **hirta** (*R. hirta* L., Sp. Pl. **2:** 907. 1753; *R. brittonii* Small, Mem. Torr. Bot. Club **4:** 130. 1894; *R. hirta* var. *brittonii* (Small) Fern., RHODORA **39:** 457. 1937; *R. amplectens* T. V. Moore, Pittonia **4:** 177. 1900; *R. monticola* Small, Torreya **1:** 67. 1901; *R. hirta* var. *monticola* (Small) Fern., RHODORA **39:** 457. 1937.).

1b. **R. hirta** L. var. **pulcherrima** Farwell, Rep. Mich. Acad. Sci. **6:** 209. 1904 (*R. serotina* Nutt., Jour. Acad. Nat. Sci. Phila. **7:** 80. 1834; *R. bicolor* Nutt., Jour. Acad. Nat. Sci. Phila. **7:** 81. 1834; *R. strigosa* Nutt., Trans. Am. Phil. Soc. N. S. **7:** 354. 1840; *R. lanceolata* Bisch., Del. Sem. Hort. Heidelb. 4. 1848, ex Walp. Ann. **2:** 855. 1852; *R. serotina* Nutt. var. *lanceolata* (Bisch.) Fern. & Schub., Rhodora **50:** 175. 1948; *R. flexuosa* T. V. Moore, Pittonia **4:** 180. 1900; *R. flava* T. V. Moore, Pittonia **4:** 179. 1900; *R. longipes* T. V. Moore, Pittonia **4:** 178. 1900; *R. sericea* T. V. Moore, Pittonia **4:** 178. 1900; *R. hirta var. sericea* (T. V. Moore) Fern., Rhodora **39:** 457. 1937; *R. serotina* var. *sericea* (T. V. Moore) Fern. & Schub., Rhodora **50:** 175. 1948; *R. flava* T. V. Moore var. *perbracteata* Lunell, Am. Mid. Nat. **2:** 157. 1912.). This widespread weed was regarded as a distinct species (*R. serotina* Nutt.) in the latest edition of Gray's Manual. Recognition of this taxon as a variety of *R. hirta* necessitates the adoption of Farwell's name, the first legitimate name in varietal rank.

1c. **R. hirta** L. var. **corymbifera** Fern., Rhodora **39:** 457. 1937. (*R. serotina* var. *corymbifera* (Fern.) Fern. & Schub., Rhodora **50:** 175. 1948.).

1d. **R. hirta** L. var. **angustifolia** (T. V. Moore), comb. nov. (*R. floridana* var. *angustifolia* T. V. Moore, Pittonia **4:** 176. 1900; *R. divergens* T. V. Moore, Pittonia **4:** 177. 1900.). This taxon has become fairly well known under the name *R. divergens* T. V. Moore. Use of the less appropriate name, as adopted above is required when this entity is placed in its proper position as a variety of *R. hirta*.

1e. **R. hirta** L. var. **floridana** (T. V. Moore), comb. nov. (*R. floridana* T. V. Moore, Pittonia **4:** 176. 1900.).

2. **Rudbeckia missouriensis** Engelm. ex Boynt. & Beadle, Biltmore Bot. Stud. **1:** 17. 1901. (*R. fulgida* Ait. var. *missouriensis* (Engelm.) Cronquist, Rhodora **47:** 401. 1945.). East-central Missouri to northwestern Arkansas; southwestern Arkansas and southeastern Oklahoma; southeastern Texas.

3. **Rudbeckia fulgida** Ait. This is one of the most complex species of subgenus *Rudbeckia*. Most of the varieties occupy fairly definite geographic ranges but there is great overlap in their distribution and morphological intergradation is considerable. The following varieties are recognized:

KEY TO THE VARIETIES OF R. FULGIDA

a. Basal leaves narrowly elliptical, narrowly lanceolate, or narrowly oblanceolate, the blades 1/3 as broad as long (Pennsylvania to Illinois, south to Florida and Louisiana) 3a. var. *fulgida*.

a. Basal leaves broadly elliptical to ovate or nearly orbicular, 1/2 to 2/3 as broad as long.

  b. Cauline leaves scarcely reduced in length up the stem, those at and just below the first branch nearly or quite as large as the lower.

c. Stem and leaves densely and retrorsely villous-hirsute, basal leaves coarsely crenate, rarely coarsely serrate, cauline leaves sharply serrate, the teeth usually small and remote (Ohio, Indiana, and Illinois)........3b. var. *deamii.*

c. Stem moderately villous-hirsute, leaves scabrous or strigose, basal leaves entire or obscurely crenate, cauline leaves coarsely serrate, commonly lacerate (Connecticut to Illinois, south to West Virginia) 3c. var. *speciosa.*

b. Cauline leaves diminishing in size gradually up the stem, the uppermost commonly reduced to the proportions of large bracts.

d. Apex of the pales eciliate; rays 2.5–4 cm. long (Michigan, Ohio, and Indiana) ....3d. var. *sullivantii.*

d. Apex of the pales prominently ciliate; rays 1–3 cm. long.

e. Leaves narrowly to broadly ovate, the base usually cordate, occasionally broadly rounded, sparingly pilose on both surfaces (Ohio, south to Alabama and Georgia) ....3e. var. *umbrosa*

e. Leaves elliptical, ovate, or orbicular; the base acute, obtuse, rounded, or truncate, never cordate; leaves minutely strigose or scabridulous.

f. Cauline leaves lanceolate to ovate-lanceolate; rays mostly 1.5–3 cm. long (Missouri and Arkansas to Oklahoma and Texas) ....3f. var. *palustris.*

f. Cauline leaves broadly spatulate, oblanceolate, or pandurate; rays mostly 1–1.5 cm. long (Virginia and Tennessee to northern Florida) 3g. var *spathulata.*

3a. **R. fulgida** Ait. var. **fulgida** (*R. fulgida* Ait., Hort. Kew. **3:** 251. 1789; *R. chrysomela* Michx., Fl. Bor. Am. **2:** 143. 1803; *R. truncata* Small, Bull. Torr. Bot. Club **25:** 478. 1898; *R. acuminata* Boynt. & Beadle, Fl. S. E. U. S. ed. 1, 1256. 1903; *R. foliosa* Boynt. & Beadle, Fl. S. E. U. S. ed. 1, 1256. 1903; *R. tenax* Boynt. & Beadle, Fl. S. E. U. S. ed. 1, 1257. 1903.).

3b. **R. fulgida** Ait. var. **deamii** (Blake), comb. nov. (*R. deamii* Blake, RHODORA **19:** 113. 1917.).

3c. **R. fulgida** Ait. var. **speciosa** (Wenderoth), comb. nov. (*R. speciosa* Wenderoth, Ind. Sem. Hort. Marb. 1828.).

3d. **R. fulgida** Ait. var. **sullivantii** (Boynt. & Beadle) Cronquist, RHODORA **47:** 400. 1945. (*R. sullivanti* Boynt. & Beadle, Biltmore Bot. Stud. **1:** 15. 1901; *R. speciosa* var. *sullivanti* (Boynt. & Beadle) Robinson, RHODORA **10:** 68. 1908.).

3e. **R. fulgida** Ait. var. **umbrosa** (Boynt. & Beadle), Cronquist, RHODORA **47:**400. 1945. (*R. umbrosa* Boynt. & Beadle, Biltmore Bot. Stud. **1:** 16. 1901; *R. chapmani* Boynt. & Beadle, Biltmore Bot. Stud. **1:** 14. 1901.).

3f. **R. fulgida** Ait. var. **palustris** (Eggert), comb. nov. (*R. palustris*

Eggert ex Boynt. & Beadle, Biltmore Bot. Stud. **1:** 16. 1901; *R. coryi* Shinners, Field & Lab. **17:** 59. 1949.).

3g. **R. fulgida** Ait. var. **spathulata** (Michx.), comb. nov. (*R. spathulata* Michx. Fl. Bor. Am. **2:** 144. 1803.).

4. **Rudbeckia mollis** Ell., Sketch **2:** 453. 1823. Southeastern Georgia and northeastern Florida.

5. **Rudbeckia heliopsidis** T. & G., Fl. N. Am. **2:** 310. 1842. Very local, southeastern Virginia to eastern Alabama.

6. **Rudbeckia grandiflora** (Sweet) DC.

KEY TO THE VARIETIES OF R. GRANDIFLORA

a. Leaves conspicuously pilose, the surface soft to the touch, the hairs mostly 1 mm. long or longer; lower portion of the stem distinctly pubescent (Central Arkansas, west to eastern Oklahoma, south to northeastern Texas; Georgia) 6a. var. *grandiflora*.

a. Leaves not conspicuously pubescent, either scabrous or hirsute, or rarely, nearly glabrous, the surface very rough to the touch, the hairs mostly about 0.5 mm. long; lower portion of the stem nearly glabrous (Central Arkansas to Louisiana and eastern Texas) ....6b. var. *alismaefolia*.

6a. **R. grandiflora** (Sweet) DC. var. **grandiflora** (*R. grandiflora* (Gmel.) DC., Prodromus **5:** 556. 1836; *Centrocarpha grandiflora* Sweet, Brit. Fl. Gard. (ser. 2) **1:** pl. 87. 1831. The correct author citation for this taxon has been discussed by Shinners in Field and Lab. **17:** 62–63. 1949.

6b. **R. grandiflora** (Sweet) DC. var. **alismaefolia** (T. & G.) Cronquist, Rhodora **47:** 401. 1945. (*R. alismaefolia* T. & G., Fl. N. Am. **2:** 310. 1842.).

7. **Rudbeckia subtomentosa** Pursh, Fl. Am. Sept. **2:** 575. 1814. (*R. tomentosa* Ell., Sketch **2:** 453. 1823; *R. odorata* Nutt., Jour. Acad. Phila. **7:** 78. 1834; *R. subtomentosa* Pursh var. *craigii* Sherff, Rhodora **14:** 164. 1912; *R. intermedia* McLeland, Nat. Hort. Mag. **2:** 16. 1923. Michigan to Wisconsin, southwest to Louisiana and Oklahoma.

8. **Rudbeckia triloba** L.

KEY TO THE VARIETIES OF R. TRILOBA

a. Mature disk 0.6–1.3 cm. broad; rays 0.8–1.7 cm. long.
  b. Stem leaves merely toothed or palmately 3-lobed (Connecticut to Michigan and Iowa, south to Texas and Georgia) ....8a. var. *triloba*.
  b. Stem leaves pinnately 5–7-lobed (western North Carolina and western Florida) ....8b. var. *pinnatiloba*.
a. Mature disk 1.4–2 cm. broad, rays 1.8–3 cm. long, (western North Carolina and eastern Tennessee) ....8c. var. *rupestris*.

8a. **R. triloba** L. var. **triloba** (*R. triloba* L. Sp. Pl. **2:** 907. 1753; *R. Beadlei* Small, Fl. S. E. U. S. ed. 1, 1258. 1903; *R. triloba* L. var. *Beadlei* (Small) Fern., RHODORA **39:** 458. 1937.).

8b. **R. triloba** L. var. **pinnatiloba** T. & G., Fl. N. Am. **2:** 309. 1842; (*R. triloba* L. β *pinnatiloba* T. & G., Fl. N. Am. **2:** 309. 1842; *R. pinnatiloba* (T. & G.) Beadle, Bot. Gaz. **25:** 277. 1898.).

8c. **R. triloba** L. var. **rupestris** (Chickering) Gray, Syn. Fl. N. Am. **1**(2): 260. 1884; (*R. rupestris* Chickering, Bot. Gaz. **6:** 188. 1881.).

9. **Rudbeckia graminifolia** (T. & G.) Boynt. & Beadle, Biltmore Bot. Stud. **1:** 12. 1901. (*Echinacea ? atrorubens β ? graminifolia* T. & G., Fl. N. Am. **2:** 306. 1842; *R. atrorubens* of Gray, Syn. Fl. N. Am. **1**(2): 259. 1884, not Nutt.).—U. S. DEPARTMENT OF AGRICULTURE, AGRICULTURAL RESEARCH SERVICE, CROPS RESEARCH DIVISION, BELTSVILLE, MD.

PARAFORMALDEHYDE AS A SOURCE OF FORMALDEHYDE FOR USE IN BOTANICAL COLLECTING

J. S. WOMERSLEY

SINCE 1946 the author has been using the "formalin technique" for the preparation of botanical specimens under tropical conditions. Various modifications have been made to the technique employed since first used in New Guinea.

The method as now used requires the following materials in addition to the usual equipment of a botanist engaged in collecting in tropical forests:—

(1) Newspaper or newsprint, preferably cut by guillotine to 17½″ x 11½″ with the fold on one of the long sides.
(2) Latticed frames, 18″ x 12″, constructed of 1″ x ¼″ dressed timber, spaced 1″ apart in the lattice and nailed at all points of contact between the horizontal and vertical members.
(3) An aqueous solution containing approximately 4% formaldehyde by weight.
(4) A rectangular tank with inside measurements 18½″ x 12½″ and of 12″ depth.
(5) Strong waterproof paper with an inner core of bituminised fibre of the brand known as "Sisalkraft" in Australia.

When collecting in the field botanical specimens are placed individually between sheets of newsprint. Pads of newsprint containing 10 to 12 sheets with fold on the left enclosed in a single folded sheet with fold on the right provide a ready means of collecting the 10–12 duplicates of each species generally secured by the author. Each packet then represents the material collected of each number. These packets are placed between a